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MODEL 139B
PULSE GENERATOR

E-H RESEARCH LABORATORIES, INC.
163 ADELINE STREET · OAKLAND, CALIFORNIA 94607

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163 ADELINE STREET · OAKLAND, CALIFORNIA 94607 · (415) 834-3030 · TWX-910-366-7258
IN EUROPE: E-H Research Laboratories (Ned) N.V., P.O. Box 402, Eindhoven, The Netherlands

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FOREWORD

Units, abbreviations and prefixes of the International System of Units (SI) are used in this manual. Discrepancies may be noted between the terms used in the text and the instrument panel markings (e. g. ; hertz, kilohertz, megahertz for cps, kilocycles, megacycles, etc.)

The National Bureau of Standards announced its approval of the SI in February 1964, and subsequently the document was adopted by Congress as a national standard.

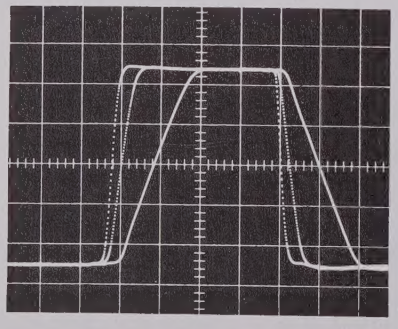
SECTION 1
CHARACTERISTICS

1-1 GENERAL

The E-H Model 139B is a solid state pulse generator that is suitable for applications requiring a pulse generator, a ramp generator, or a delay-and-gate generator. It has an extremely broad range of output pulse parameters. The pulse repetition rate is variable from 10 hertz to 50 megahertz. A separate trigger output, with an adjustable-width pulse, is useful for synchronizing an oscilloscope or another instrument. The Model 139B may be driven by another pulse generator at any repetition rate from zero to 50 megahertz. The output may be inhibited or periodically gated by an externally supplied pulse or dc-control signal.

The ramp rate feature permits separate adjustment of output pulse leading edge risetime and trailing edge falltime, within any one of 12 ramp rate ranges. The baseline offset feature allows the pulse train to be adjusted off the zero reference up to two volts, positive or negative. Output pulse waveforms may be inverted in polarity, to provide equivalent duty factors greater than 50%.

The Model 139B is packaged within a durable, heavy-duty metal frame for either rack or cabinet mounting. Coupled with the broad line of E-H pulse generator accessories, this instrument is truly an indispensable laboratory tool.



Model 139B output showing independent rise and fall times with constant amplitude. Superimposed waveforms (2v/cm, 20ns/cm).

1-2 SPECIFICATIONS

PULSE REPETITION FREQUENCY - 10 hertz to 50 megahertz from Internal clock. Zero to 50 megahertz from External clock. Repetition rate is continuously variable from 10 hertz to 50 megahertz by a coarse selector (10/30/100/300 hertz, 1/3/10/30/100 kilohertz, 0.3/1/3/10/25/50 megahertz), and a 3:1 vernier control.

OUTPUT PULSE AMPLITUDE - ±30 millivolts to 10 volts by coarse attenuator ranges of 1/3/10/30/100. Attenuation ranges are continuously variable with a 3:1 vernier control.

RISE AND FALL TIMES (10 to 90%) - 6 nanoseconds to 3 milliseconds by coarse selector (6/10/30/100/300 nanoseconds, 1/3/10/30/100/300 microseconds, 1/3 milliseconds), and independent 3:1 vernier controls for rise and fall. The output pulse rises and falls at essentially a constant dv/dt, regardless of amplitude variations, except at very fast risetimes. (At 5 volts output, the fastest risetime is less than 5 nanoseconds.) Linearity better than ±5% from 10 nanoseconds to 300 nanoseconds, ±3% from 300 nanoseconds to 3 milliseconds.

PULSE WIDTH - 10 nanoseconds to 10 milliseconds, continuously variable by coarse selector (10/30/100/300 nanoseconds, 1/3/10/30/100/300 microseconds, 1/3/10 milliseconds), and a 3:1 vernier control.

PULSE DELAY - 10 nanoseconds to 10 milliseconds, continuously variable by coarse selector (10/30/100/300 nanoseconds, 1/3/10/30/100/300 microseconds, 1/3/10 milliseconds), and a 3:1 vernier control. Approximately 50 nanoseconds fixed delay between the external drive pulse and trigger pulse.

OUTPUT TERMINATING IMPEDANCE - 50 ohms. Model 139B is designed basically as a current source with dc coupled output of approximately 50 ohms at high frequencies in the 1:1 attenuator position.

The output is completely short and open circuit protected, but is not intended for operation in the open circuit condition for extended periods.

DUTY FACTOR - Greater than 50%. If width or delay settings exceed duty factor limit, the repetition rate will automatically scale down in frequency, assuring complete overload protection.

WAVEFORM DISTORTION - Pulse top distortion less than 5% peak-to-peak. Baseline distortion less than 5% peak-to-peak, except 100:1 attenuator position which is less than 8% peak-to-peak.

BASELINE OFFSET - ±2 volts, adjustable, either polarity. The maximum peak pulse amplitude available is ±10 volts, referenced to zero. The maximum relative amplitude is 10 volts regardless of offset adjustment. Output pulses may be inverted so the baseline is at either +10 or -10 volts (depending on the amplitude setting); in this condition, the pulse reference level is also adjustable ±2 volts.

JITTER - Less than 0.1%, +50 picoseconds, including repetition rate, width, and delay jitter.

EXTERNAL DRIVE INPUT - +1.5 volts minimum, +15 volts maximum. Model 139B may be externally driven from 0 to 50 megahertz; rate of risetime for External Drive Signal ≤ 0.1 microsecond/volt. $Z_{in} \cong$ 200 ohms.

TRIGGER OUTPUT - +1.5 volts into 50 ohms. Trigger pulse width is variable from 10 nanoseconds to 50 nanoseconds. Risetime is 5 nanoseconds/volt. $Z_{out} \cong 50$ ohms.

DOUBLE PULSE OPERATION - A front-panel switch provides double pulse operation. Maximum repetition rate is 20 megahertz for 40 megahertz double pulse rate. Minimum spacing is 30% of pulse width; spacing is determined by DELAY control. Pulses are identical in amplitude, width, and polarity.

SINGLE CYCLE OPERATION - A front-panel pushbutton provides single cycle operation when depressed by the operator.

GATE INPUT - -2 volts minimum required to block pulse train, -15 volts maximum. The end of each gate signal initiates the pulse train, which synchronizes the output pulse with the gate signal. $Z_{in} \cong$ 300 ohms.

DIMENSIONS

Cabinet-mount:	6" high, 17" wide, 12" deep
Rack-mount:	7" high, 19" wide, 12" deep
Weight:	20 lbs net; 28 lbs commercial package; 37 lbs export package

POWER REQUIREMENTS

105/125 volts, 50/60 Hz, 75 volt-amperes. 230 volt service is available at no extra cost as a standard feature.

1-3 ACCESSORIES

E-H Model ZL-3 TERMINATION. This is a high-frequency, 50-ohm load with signal pick-off; three watt power dissipation rating.

E-H Model CX-5 CABLE SET. This set consists of two 5-foot cables, RG-58A/U, with 50-ohm characteristic impedance. This set is supplied with BNC connectors.

ADDITIONAL ACCESSORIES. The E-H BNC series accessories are compatible with both the E-H Model 139B and other instruments having BNC connectors. For further accessory information, refer to the data at the back of this manual.

SECTION 2
OPERATING INFORMATION

2-1 UNPACKING

Immediately after unpacking the instrument, carefully inspect and evaluate the condition of the shipping container and instrument for evidence of damage that might have occurred during shipment or handling. If damage is noted, the responsible carrier or agency should be promptly notified.

2-2 234 VOLT OPERATION

The internal power supply of the Model 139B is normally connected for 117 vac operation. Reconnect the transformer primary for operation at 234 volts. Refer to the power supply schematic diagram for the proper primary connections.

2-3 OUTPUT IMPEDANCE

Model 139B is basically a current source. Output impedance is approximately 50 ohms at high frequencies in the 1:1 attenuator position. The attenuator is back-matched to approximately 50 ohms above attenuations of 10:1. The output is short and open-circuit protected, but is not intended to operate in the open-circuit condition for extended periods. The output is designed to operate into a 50-ohm resistive load. Any other load impedance will cause some pulse distortion. Loads with appreciable capacitive or inductive components will have an appreciable effect on the leading and trailing edges of the pulse. Use the E-H Model ZT Pulse Transformer to match the Model 139B output to other impedances.

NOTE

For best waveform fidelity, the Model 139B terminating impedance should always be as close to 50 ohms as possible.

2-4 CABLES, CONNECTORS AND ATTENUATORS

The sharp risetime of the 139B has appreciable frequency components up to about 200 megahertz. If any of these high frequency components are attenuated through the use of connectors, cables, or attenuators that do not have a flat frequency response in excess of these frequencies, degradation of the pulse risetime will result. Mismatch effects can also degrade the pulse waveform: consequently, consideration and care must be taken to preserve the quality of the Model 139B pulse output when coupling it to the system or device under test.

Some of the precautions to observe in coupling the pulse outputs of this instrument are:

(1) Always terminate the output of the Model 139B in a 50-ohm resistive load.

(2) If the input impedance of the device or system under test is other than 50 ohms, use an impedance matching device so that mismatch effects will not degrade the pulse waveform.

(3) Make sure that all connectors, attenuators, and cables are of proper impedance and have a flat frequency response in excess of 200 megahertz. Use only high quality 50-ohm coaxial cable, such as RG-58A/U or RG-213/U with properly matched connectors.

2-5 OPERATING CONTROLS AND CONNECTORS

The front panel operating controls and connectors are listed in Table 2-1.

2-6 OPERATING NOTES

a. DUTY FACTOR CONSIDERATIONS. For best results, pulse width plus delay time should be less than the pulse period. Pulse width should be less than 50% of the pulse period. To obtain duty factors greater than 50%, invert the output pulse with the polarity control. (See Figure 2-1.)

For example, with positive inverted (+INV) pulses, the main duty factor limitation is the minimum pulse width, which is 10 nanoseconds. Thus, if the output pulse period is 20 nanoseconds (50 megahertz) and the minimum pulse width is 10 nanoseconds, then maximum duty factor is 50%. If the pulse width remains constant, but period is increased (frequency is decreased), the effective duty factor will increase.

b. OFFSET. The OFFSET control, located above the POLARITY selector switch, provides baseline offset of ±2 volts. Maximum output amplitude of the Model 139B is ±10 volts.

TABLE 2-1 OPERATING CONTROLS AND CONNECTORS

ITEM	FUNCTION
POWER	With the line cord connected to a 115-vac, 50/60 hertz, power source and with the POWER switch set to its ON position, the cooling fan is energized and the POWER indicator light turns on. To de-energize the instrument, set the POWER switch to its OFF position.
FREQ. RANGE	Selects 1 of 14 repetition rate ranges (10 hertz to 50 megahertz) or the external drive function. Pulse repetition rate ranges are: 10/30/100/300 hertz; 1/3/10/30/100 kilohertz; 0.3/1/3/10/25/50 megahertz.
FINE (FREQ. RANGE)	Varies pulse repetition rate within the selected frequency range, with overlap to adjacent ranges.
DELAY	Selects 1 of 12 delay time ranges where delay time is the interval between the trigger pulse and the output pulse. Delay ranges are: 10/30/100/300 nanoseconds; 1/3/10/30/100/300 microseconds; and 1/3/10 milliseconds.
FINE (DELAY)	Varies delay time within the selected DELAY range, with overlap to adjacent ranges.
WIDTH	Selects 1 of 12 output pulse width ranges (10 nanoseconds to 10 microseconds). Pulse width ranges are: 10/30/100/300 nanoseconds; 1/3/10/30/100/300 microseconds; and 1/3/10 milliseconds.
FINE (WIDTH)	Varies output pulse width within the selected WIDTH range, with overlap to adjacent ranges.
RAMP RATE/10V	Selects 1 of 16 output pulse rise and fall (voltage ramp) time ranges (6 nanoseconds to 300 microseconds). Ramp rate ranges are: 6/10/30/100/300 nanoseconds; 1/3/10/30/100/300 microseconds; and 1/3/10/30/100/300 milliseconds. Rise and fall times are individually adjustable with the RISE and FALL controls, with a ratio from 1:1 to 3:1 between rise and fall times possible.
RISE (RAMP RATE/10V)	Varies output pulse rise time (voltage ramp) within the range selected by the RAMP RATE/10V control.
FALL (RAMP RATE/10V)	Varies output pulse fall time (voltage ramp) within the range selected by the RAMP RATE/10V control.
POLARITY	Selects the output pulse polarity from one of four possible modes (+INV, +Normal, -Normal, and -INV). For further details, see Section 2-6a.
OFFSET	Adjusts the output pulse baseline voltage level. If the ATTENUATOR switch is set to 1, the baseline offset adjustment is continuous between +2 volts to -2 volts, regardless of output pulse polarity. For further details, see Section 2-6b.

TABLE 2-1 OPERATING CONTROLS AND CONNECTORS
(CONTINUED)

ITEM	FUNCTION
ATTENUATOR	Selects one of four resistive attenuation ratios or a straight-through connection. Available attenuation ratios are 1:1, 3:1, 10:1, 30:1, and 100:1.
AMPLITUDE	Varies the output pulse amplitude. If the ATTENUATOR switch is set to 1, the AMPLITUDE control provides continuous output pulse amplitude adjustment from ±3 to ±10 volts.
TRIGGER WIDTH	Provides continuous TRIGGER OUTPUT pulse width adjustment from 10 to 50 nanoseconds, approximately.
PULSE MODE	When set to the SINGLE position, there is one output pulse during the pulse repetition period; the output pulse follows the trigger pulse by the delay time. When set to the DOUBLE position, there are two output pulses during the pulse repetition period; the first output pulse is approximately coincident with the trigger pulse and the second output pulse occurs at a later time that is determined by the DELAY controls. For optimum operation the delay time should be approximately 30% greater than the output-pulse width, but less than approximately 75% of the output pulse repetition period.
SINGLE CYCLE	With the FREQ. RANGE selector switch set to EXT. and with no external-drive signal applied to the instrument, the SINGLE CYCLE pushbutton switch initiates a single output pulse each time it is depressed. The SINGLE CYCLE switch provides one-time triggering action.
OUTPUT CONNECTOR (BNC)	The OUTPUT connector supplies the output pulse train to an external 50-ohm load. When the ATTENUATOR switch is set to 1, the OUTPUT appears to the load as a current source. The Model 139B is completely short and open circuit protected, but it is not intended for operation in the open circuit condition for extended periods.
TRIGGER OUTPUT CONNECTOR (BNC)	Provides a +1.5 volt trigger-pulse output into a 50-ohm load. To prevent ringing and resultant spurious triggering, the TRIGGER OUTPUT load impedance should always be 50 ohms. The trigger pulse may be used to synchronize an oscilloscope, another pulse generator, or other instruments.
GATE INPUT CONNECTOR (BNC)	Permits a negative pulse of d-c level of -2 volts to -15 volts to inhibit the pulse-generator output. The positive-going edge of the gating signal initiates the output pulse train, to provide synchronous gating operation of the pulse generator. The GATE INPUT impedance is approximately 300 ohms.
EXTERNAL DRIVE INPUT CONNECTOR (BNC)	Permits an externally-supplied pulse train, with an amplitude from +1.5 to +15 volts at a pulse repetition rate from zero to 50 megahertz, to drive the Model 139B. Maximum external drive input pulse risetime is 0.1 microsecond/volt. The external DRIVE INPUT impedance is approximately 200 ohms.

The offset operates by the summing currents from a fixed, negative source and a variable positive source. The fixed negative current is -40 milliamperes. For +2 volts offset, the positive source provides +80 milliamperes more than required for pulse operation. For -2 volts offset it provides zero current. (See Figure 2-2 and Table 2-1.)

c. GATE INPUT OPERATION. The gate circuit disables the clock circuit for the duration of the GATE INPUT signal.

If the gate signal is repetitive, the output signal of the Model 139B will be a series of pulse bursts. These bursts are separated in time by the gate pulse width. The duration of each burst is determined by the time the gate signal is off. The frequency of the pulse bursts is determined by the gate pulse period.

For example, suppose the desired pulse bursts are to recur every 100 microseconds. There are to be 5 pulses in each burst, and each pulse in the burst is to recur every 10 microseconds.

For these conditions, adjust the GATE pulse generator for a 10 kilohertz repetition rate (gate pulse period = 100 microseconds). For 5 pulses in each burst, the clock multivibrator should remain on longer than 40 microseconds, but less than 50 microseconds. Therefore, the gate pulse width should be somewhat greater than 50 microseconds, but less than 60 microseconds (gate pulse duty factor ≅ 50%). For 10 microseconds pulse repetition period on the Model 139B, adjust the internal clock to 100 kilohertz (pulse period = 10 microseconds).

d. RAMP RATE OPERATION. As ramp rate is increased, also increase the pulse width and decrease the repetition rate as necessary. Pulse width should be greater than the risetime, or the output pulse amplitude and waveform tends to degenerate.

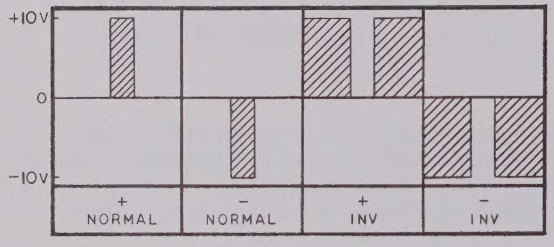


Figure 2-1 Duty Factor vs Output Pulse Polarity

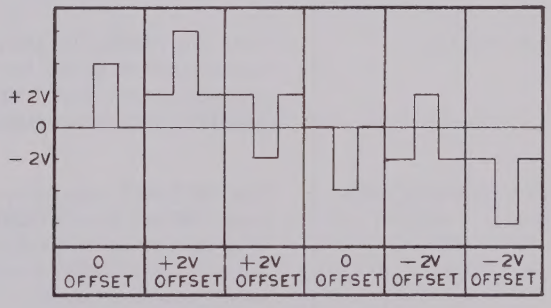


Figure 2-2 Output Pulse Baseline Offset

SECTION 3
PARTS LIST

3-1 ORDERING INFORMATION

Replacement parts may be ordered through your E-H Representative or from the factory. To be certain that you receive the proper replacement parts, always include the following information with your order:

a. Model Number and Serial Number of the instrument on which the replacement parts will be installed.

b. Circuit or Drawing Reference for which each part is intended.

c. E-H Part Number.

This instrument contains several factory-selected components to ensure optimum performance. In no case should a diode or transistor be replaced with one from a different manufacturer, unless it is on the specific recommendation of E-H.

When replacement parts are necessary, be sure to order through the E-H Customer Service organization. In this way, we can best serve you by providing up-to-date factory recommended parts and service information.

3-2 WARRANTY

This instrument is guaranteed to be free from defects in material and workmanship. Our obligation is limited to repairing the instrument should it prove to be defective, upon our examination, within one (1) year after the purchase date. Fuses and batteries are specifically excluded from warranty. Electron tubes, transistors, and diodes are warranted for six (6) months.

For In-Warranty repair of this instrument, contact E-H Research Laboratories, Inc., Customer Service Department, and provide:

a. Instrument Model Number and Serial Number.

b. Full details concerning the nature of the malfunction.

Shipping instructions, or repair information and parts, will be sent to you promptly.

CUSTOMER SERVICE DEPARTMENT, E-H RESEARCH LABORATORIES, INC.

163 ADELINE STREET, OAKLAND, CALIFORNIA -Phone: TE 4-3030, Area Code 415

CIRCUIT REFERENCE	DESCRIPTION	E-H PART NO.
3-3 TIMING CIRCUIT		
	P. C. Board, Timing Circuit	11395
C5	Cap., Cer., 10 pf, 1 kv	311-001
C9, 12, 16	Cap., Cer., 50 pf, 1 kv	311-006
C14	Cap., Cer., 400 pf, 1 kv	311-026
C2, 3, 4, 6, 8, 10, 13, 15, 17, 18, 19,	Cap., Cer., 0.001 μf/1kv	311-010
C1	Cap., Cer., 0.01 μf/600v	311-012
C7	Cap., Cer., 0.1 μf/75v	311-014
C11	Cap., Cer., 25 μf/25v	316-028
L3	Choke, molded 0.33 uh, 10%	335-010
L1, 2	Choke, molded 0.22 uh, 20%	335-014
L4, 5	Choke, molded 0.47 uh, 20%	335-019
CR12, 14, 16, 18, 28, 33	Diode, 1N753 (Matched Pairs)	11730
CR3-4, 6, 9	Diode, 1N751A (Matched Pairs)	11731
CR5, 7, 10, 11, 13, 17, 27, 29-31, 32, 34-42	Diode, CGD1419	11742
CR15, 19	Diode, 1N751A	374-022
CR20, 21, 22, 23, 24	Diode, 1N914B	376-022
CR26	Diode, 1N270	376-031
CR25	Diode, Tunnel, RCA 40065	376-044
CR1, 2, 8	Diode, FD777	376-059
R1	Pot., Min 100, 1/2W, 10%, WW	551-024
R21	Pot., Min 2K, 1/2W, 10%, WW	551-023
R4, 8	Resistor, 5.1, 1/4W, 5%	595-051
R37, 46, 55, 60, 66, 25, 28, 34	Resistor, 51Ω, 1/4W, 5%	595-510
R12, 13, 18, 31, 41	Resistor, 100Ω, 1/4W, 5%	595-101
R17	Resistor, 150Ω, 1/4W, 5%	595-151
R9	Resistor, 160Ω, 1/4W, 5%	595-161
R62, 68 75	Resistor, 200Ω, 1/4W, 5%	595-201
R7, 10, 48, 56, 61	Resistor, 220Ω, 1/4W, 5%	595-221
R3	Resistor, 240Ω, 1/4W, 5%	595-241
R69, 70	Resistor, 300Ω, 1/4W, 5%	595-301
R6, 52	Resistor, 560Ω, 1/4W, 5%	595-561
R57	Resistor, 620Ω, 1/4W, 5%	595-621
R22	Resistor, 750Ω, 1/4W, 5%	595-751
R2, 72	Resistor, 1K, 1/4W, 5%	595-102
R67, 74	Resistor 1.1K, 1/4W, 5%	595-112
R26, 35, 63	Resistor, 1.2K, 1/4W, 5%	595-122
R5, 11, 16, 29, 38	Resistor, 1.5K, 1/4W, 5%	595-152
R49	Resistor, 1.6K, 1/4W, 5%	595-162
R14, 23, 53, 65, 71, 73	Resistor, 2K, 1/4W, 5%	595-202
R20	Resistor, 2.2K, 1/4W, 5%	595-222
R24, 32, 33, 40, 54, 59, 64	Resistor, 3K, 1/4W, 5%	595-302
R50	Resistor, 5.1K, 1/4W, 5%	595-512
R42	Resistor, 10K, 1/4W, 5%	595-103
R47	Resistor, 100K, 1/4W, 5%	595-104
R43	Resistor, 22 meg, 1/4W, 5%	595-226
R19, 39	Resistor, 330Ω, 1/2W, 5%	596-331
R30	Resistor, 470Ω, 1/2W, 5%	596-471
R27, 36, 58	Resistor, 560Ω, 1/2W, 5%	596-561
R15	Resistor, 750Ω, 1/2W, 5%	596-751
R44	Resistor, 1.2K, 1/2W, 5%	596-122
R45	Resistor, 1.6K, 1/2W, 5%	596-162
R51	Resistor, 510Ω, 1W, 5%	597-511
	Socket, Transistor	490-003
Q7	Transistor, CDQ 10239	11701
Q2, 3 19	Transistor, 2N2369	663-009
Q5, 6, 8-18	Transistor, E-H 136	11475
Q4	Transistor, E-H 805	11722
Q1	Transistor, 2N3227	663-072
3-4 OUTPUT CIRCUIT		
ASSEMBLY PHASE 1		
	P. C. Board, Output Circuit	10953
C7, 8, 10	Capacitor, Cer., .001 ufd	311-010
C1, 2, 9	Capacitor, Cer., .01mfd/600v	311-012
C4, 6, 12, 13, 14	Capacitor, Cer., 0.1 μf/75v	311-014
C11, 16, 22	Capacitor, Mono, 2.2 μf/25v	311-019
C3	Capacitor, Cer., .05 μf/75v	311-021
C23, 24	Capacitor, El., 100 μf/25v	316-035
C5	Capacitor, El., 25 μf/25v	316-028
L4	Choke, Min., 0.33 μf	335-010
L3, 5	Choke, Min., 2.2 μf	335-016
CR9, 10	Diode, 1N759A (Matched Pair)	11733
CR19	Diode, 1N3789A	374-027
CR11	Diode, 1N749A	374-044
CR20	Diode, 1N914B	376-022

CIRCUIT REFERENCE	DESCRIPTION	E-H PART NO.
CR1, 2, 3, 4, 5, 6, 7, 8	Diode, 1N270	376-031
CR17	Diode, FD777	376-059
L6	Inductor, (3T 3E)	10995
L1, 7	Inductor	10956
L8	Inductor, (12T 2)	10996
R50	Resistor, 30Ω, 1/4W, 5%	595-300
R44	Resistor, 33Ω, 1/4W, 5%	595-330
R46	Resistor, 100Ω, 1/4W, 5%	595-101
R1, 2, 5, 6	Resistor, 1.3K, 1/4W, 5%	595-132
R47	Resistor, 10Ω, 1/4W, 5%	595-010
R48	Resistor, 20Ω, 1/2W, 5%	596-200
R30	Resistor, 51Ω, 1/2W, 5%	596-510
R3, 4	Resistor, 62Ω, 1/2W, 5%	596-620
R19	Resistor, 91Ω, 1/2W, 5%	596-910
R27	Resistor, 160Ω, 1/2W, 5%	596-161
R28	Resistor, 180Ω, 1/2W, 5%	596-181
R35	Resistor, 200Ω, 1/2W, 5%	596-201
R43	Resistor, 220Ω, 1/2W, 5%	596-221
R7	Resistor, 240Ω, 1/2W, 5%	596-241
R31	Resistor, 270Ω, 1/2W, 5%	596-271
R36	Resistor, 470Ω, 1/2W, 5%	596-471
R39	Resistor, 510Ω, 1/2W, 5%	596-511
R34, 41	Resistor, 1K, 1/2W, 5%	596-102
R32	Resistor, 1.3K, 1/2W, 5%	596-132
R51	Resistor, 1.6K, 1/2W, 5%	596-162
R24	Resistor, 1.8K, 1/2W, 5%	596-182
R14, 33, 40	Resistor, 2K, 1/2W, 5%	596-202
R25, 29	Resistor, 2.2K, 1/2W, 5%	596-222
R21	Resistor, 3K, 1/2W, 5%	596-302
R15	Resistor, 3.3K, 1/2W, 5%	596-332
R10, 20	Resistor, 3.6K, 1/2W, 5%	596-362
R11, 12	Resistor, 5.1K, 1/2W, 5%	596-512
R16	Resistor, 6.2K, 1/2W, 5%	596-622
R9	Resistor, 18K, 1/2W, 5%	596-183
R22	Resistor, 10Ω, 1W, 5%	597-100
R18, 23	Resistor, 180Ω, 1W, 5%	597-181
R26	Resistor, 240Ω, 1W, 5%	597-241
R38	Resistor, 330Ω, 1W, 5%	597-331
R17	Resistor, 430Ω, 1W, 5%	597-431
	Socket, Transistor	490-002
	Socket, Transistor	490-003

ASSEMBLY PHASE 2

C19	Capacitor, P. C., 300 pf	10952
C15	Capacitor, P. C., 13 pf	11371
C17	Capacitor, Cer., .001 undipped	312-001
C18	Capacitor, Cer., .01 undipped	312-003
C21	Capacitor, Cer., .001 μfd	311-010
C20	Capacitor, Mono, 0.1 μf/50v	311-034
CR16, 18	Diode, CGD 1419	11742
CR12, 13, 14, 15	Diode, FD 777	376-059
	Finger Stock	10663
	Heat Sink	490-018
	Heat Sink	490-019
	Heat Sink Adapter	10971
L2	Inductor	10732
R13	Potentiometer, 1K	550-031
R49	Resistor, 20Ω, 1/2W, 5%	596-200
R8, 37, 42	Resistor, 200Ω, 1/4W, 5%	595-201
R45	Resistor, 2.7K, 1/2W, 5%	596-272
Q10	Transistor, 2N2950	663-039
Q11	Transistor, SM 2056	11716
Q9	Transistor, E-H 805	11722
Q15	Transistor, GP 273	11705
Q12	Transistor, 2N1143	663-006
Q5, 7	Transistor, 2N1132	663-024
Q3, 8	Transistor, 2N834	663-028
Q1, 2, 4	Transistor, 2N966	663-032

3-5 POWER SUPPLY

POWER SUPPLY CHASSIS

	Chassis, Power Supply	10945
R102	Pot., Locking, A.B., 1K	545-003
R103	Pot., Locking, 500Ω, 2W	545-034
R104	Pot., Locking, A.B., 10K	545-006
R105	Pot., Locking, A.B., 25K	545-007
	Connector, P.C. 18-pin	743-008
R106	Resistor, 7.5K, 1/2W, 5%	596-752
C104	Capacitor, 0.1μf/75v	311-014
C105	Capacitor, .01 mfd/600v	311-012
	Transistor Mtg. Kit	490-001
C101, 102	Capacitor, El., 1500μfd/50v	316-045
C103	Capacitor, El., 250μfd/50v	316-025
Q101-106	Transistor, 2N250, GP 273	11705
L101	Inductor, Fixed	10563
T101	Transformer, Power	11170
	Terminal Board, 10-pin	480-005
CR101-108	Diode, 1N4005	376-034
R101	Resistor, 5Ω, 3W, WW	610-003

POWER SUPPLY REGULATOR

	P. C. Board	10938

CIRCUIT REFERENCE	DESCRIPTION	E-H PART NO.
C2, 3, 6, 9	Capacitor, El., 100 μf/25v	316-035
C7	Capacitor, El., 50 μf/25v	316-037
CR1	Diode, 1N3785A	374-028
R26	Resistor, 5.1Ω, 1/2W, 5%	596-051
R13	Resistor, 220Ω, 1/2W, 5%	596-221
R2	Resistor, 330Ω, 1/2W, 5%	596-331
R3	Resistor, 10K, 1/2W, 5%	596-103
R7	Resistor, 620Ω, 1/2W, 5%	596-621
R6	Resistor, 680Ω, 1/2W, 5%	596-681
R1, 8, 11, 12, 17, 22	Resistor, 1K, 1/2W, 5%	596-102
R21	Resistor, 1.5K, 1/2W, 5%	596-152
R4, 9	Resistor, 2K, 1/2W, 5%	596-202
R10	Resistor, 3.3K, 1/2W, 5%	596-332
R18	Resistor, 18K, 1/2W, 5%	596-183
R25	Resistor, 75K, 1/2W, 5%	596-753
R16	Resistor, 100K, 1/2W, 5%	596-104
R19, 20, 23, 24	Resistor, 2K, 1/2W, 1%	618-005
R14	Resistor, 3.01K, 1/2W, 1%MF	618-018
R15	Resistor, 5.11K, 1/2W, 1%	601-076
Q3, 4, 5	Transistor, 2N1303	663-011
Q1, 2	Transistor, CDQ10239	11701
	Bracket	10946
	Heat Sink	490-018
C1, 4, 5, 8	Capacitor, 25μf/25v	316-028
R5	Resistor, 470Ω, 1/2W, 5%	596-471

3-6 CHASSIS AND PANEL COMPONENTS

FRONT PANEL

	Front Panel	11330
DS201	Pilot Light	510-008
R201, 206, 208, 211	Potentiometer, 5K, 2W	550-003
R212, 214, 216, 219	Potentiometer, 1K, 2W	550-002
S207, 209	Switch, Toggle	630-006
S208	Switch, Pushbutton	635-003
S206	Switch, Attenuator	11630
J201, 202, 203	Connector, BNC UG1094/U	721-013
	Connector, BNC UG909/U	721-014
R213	Resistor, 3.9K, 1/2W, 5%	596-392
R223	Resistor, 100K, 1/2W, 5%	596-104
R207	Resistor, 470Ω, 1/4W, 5%	595-471

CIRCUIT REFERENCE	DESCRIPTION	E-H PART NO.
FREQUENCY RANGE SWITCH		
C215	Capacitor, Ceramic, 10 pf	311-001
C214	Capacitor, Ceramic, 75 pf	311-025
C213, 212	Capacitor, Ceramic, 20 pf	311-002
C216	Capacitor, Ceramic, 400 pf	311-026
C217	Capacitor, Ceramic, 0.001μf	311-033
C218	Capacitor, Poly, 4300 pf	326-017
C201	Capacitor, Mylar, 0.015 μf	320-031
C202	Capacitor, Mylar, 0.047 μf	320-032
C203	Capacitor, Mylar, 0.15 μf	320-036
C204	Capacitor, Mylar, 0.47 μf	320-035
C205	Capacitor, Mylar, 1.5 μf, 20V	320-037
C206	Capacitor, Tant., 4.7 μf, 20V	318-002
C207	Capacitor, Tant., 15 μf, 20V	318-009
C208, 209, 211, 210	Capacitor, Tant., 47 μf, 20V	318-001
R202	Resistor, 3.9K, 1/4W, 5%	595-392
R203	Resistor, 1K, 1/4W, 5%	595-112
S201	Switch, Centralab per E-H	624-048
DELAY SWITCH		
S202	Switch, Rotary, Ceramic	624-007
C224	Capacitor, Ceramic, 10 pf	311-001
C223	Capacitor, Ceramic, 200pf, 10%	311-028
C228	Capacitor, Tant., 0.68 μf	318-010
C227	Capacitor, Tant., 2.7 μf	318-011
C226	Capacitor, Tant., 6.8 μf	318-012
C225	Capacitor, Tant., 22 μf	318-013
C219	Capacitor, Mylar, 0.025 μf	320-017
C230	Capacitor, Mylar, 0.07 μf	320-020
C229	Capacitor, Mylar, 0.25 μf	320-021
C220	Capacitor, Poly, 7000 pf	326-008
C221	Capacitor, Poly, 2500 pf	326-011
C222	Capacitor, Poly, 620 pf	326-013
R205	Resistor, 1.2K, 1/4W, 5%	595-122
R204	Resistor, 2.7K, 1/4W, 5%	595-272
WIDTH SWITCH		
S203	Switch, Rotary, Ceramic	624-007
C234	Capacitor, Ceramic 250 pf	311-004
C235	Capacitor, Ceramic 400 pf	311-026
C236	Capacitor, Ceramic, 200 pf	311-028
C239	Capacitor, Tant., 1.8 μf	318-008
C241, 240	Capacitor, Tant., 0.68 μf	318-010
C238	Capacitor, Tant., 6.8 μf	318-012
C237	Capacitor, Tant., 22 μf	318-013
C231	Capacitor, Mylar, 0.025 μf	320-017
C243	Capacitor, Mylar, 0.07 μf	320-020
C242	Capacitor, Mylar, 0.25 μf	320-021
C232	Capacitor, Poly, 7000 pf	326-008

CIRCUIT REFERENCE	DESCRIPTION	E-H PART NO.
C233	Capacitor, Poly, 2500 pf	326-001
R210	Resistor, 1.2K, 1/4W, 5%	595-122
R209	Resistor, 2.7K, 1/4W, 5%	595-272

RAMP RATE SWITCH

S204	Switch, Deck	624-020
S204	Switch, Index	624-029
C245	Capacitor, Ceramic 250 pf	311-004
C246	Capacitor, Ceramic, 820 pf	311-027
C253	Capacitor, Tant., 2.7 μf, 20v	318-011
C252	Capacitor, Tant., .82 μf, 20v	318-014
C254	Capacitor, Tant., 8.2 μf, 20v	318-015
C249	Capacitor, Ceramic, .025 μf	320-017
C250	Capacitor, Mylar, .07 μf	320-020
C251	Capacitor, Mylar, .25 μf	320-021
C248	Capacitor, Poly, 7000 pf	326-008
C247	Capacitor, Mylar, 2500 pf	326-011
C244	Capacitor, 50 pf	311-006
R215, 218	Resistor, 2.2K, 1/2W, 5%	596-222

POLARITY SWITCH

S205	Switch, Rotary, Ceramic	624-041
R222	Resistor, 10K, 1/2W, 5%	596-103
R221	Resistor, 5.1K, 1/2W, 5%	596-512
R217, 220	Resistor, 330Ω, 1/2W, 5%	596-331

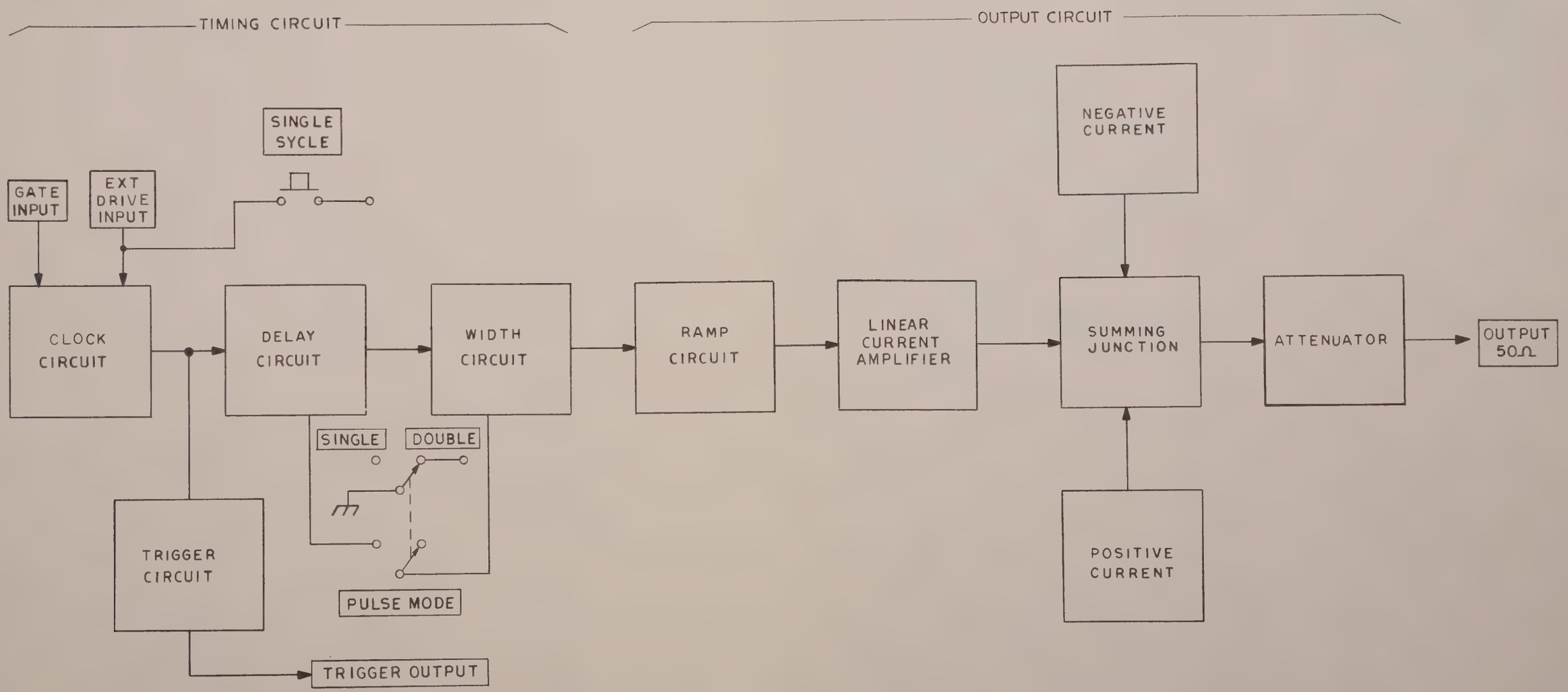
REAR PANEL

	Rear Panel	10958
P101	Power Receptable	700-018
XF101	Fuse Holder	396-001
B101	Fan Motor	570-001
	Fan Blade, CCW	493-004
	Venturi Tube	10322
	Motor Mount	10327

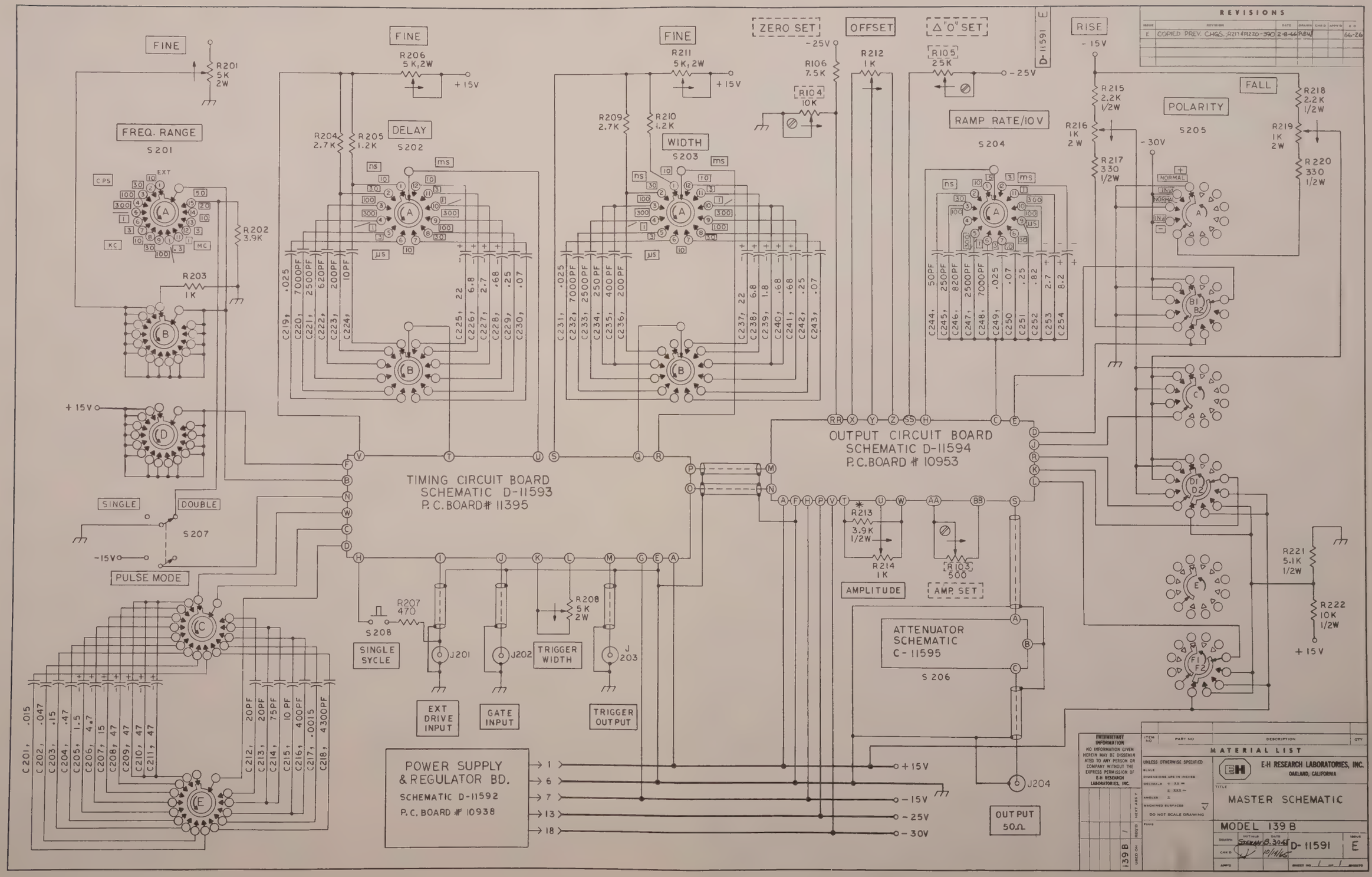
MISCELLANEOUS

	Frame	10287
	Connector Board Runner	10444
	Cover, Rectifier Board	11037
	Delay Line Assembly	11397
F101	Fuse 3/4 amp., S.B.	398-017
	Knob, Med., 1-1/4"	443-008
	Knob, Small 1"	443-009
	Knob, Skirtless, 5/8"	443-016
	Insulator, Cap., 3-1/2" Lg.	330-007
	Insulator, Cap., 3" Lg.	330-003
	Cover, Bottom	10446
	Cover, Top	10975
	Rubber Feet	417-002

CIRCUIT REFERENCE	DESCRIPTION	E-H PART NO.
	Power Cord	786-001



MODEL 139B SIMPLIFIED BLOCK DIAGRAM


REVISIONS
ISSUE REVISION DATE DRAWN CHK'D APPV'D E.O.
E COPIED PREV. CHGS., R211 & R220-390 2-8-66 PBW 66-26
D-11591 E
FINE
R201 5K 2W
FREQ. RANGE
S201
CPS
EXT
KC
MC
R202 3.9K
R203 1K
FINE
R206 5K, 2W
+15V
DELAY
S202
R204 2.7K
R205 1.2K
ns
ms
µs
C219, .025
C220, 7000PF
C221, 2500PF
C222, 620PF
C223, 200PF
C224, 10PF
C225, 22
C226, 6.8
C227, 2.7
C228, .68
C229, .25
C230, .07
FINE
R211 5K, 2W
+15V
WIDTH
S203
R209 2.7K
R210 1.2K
C231, .025
C232, 7000PF
C233, 2500PF
C234, 250PF
C235, 400 PF
C236, 200PF
C237, 22
C238, 6.8
C239, 1.8
C240, .68
C241, .68
C242, .25
C243, .07
ZERO SET
-25V
R106 7.5K
R104 10K
OFFSET
R212 1K
Δ"0" SET
R105 25K
-25V
RAMP RATE/10V
S204
C244, 50PF
C245, 250PF
C246, 820PF
C247, 2500PF
C248, 7000PF
C249, .025
C250, .07
C251, .25
C252, .82
C253, 2.7
C254, 8.2
RISE
-15V
R215 2.2K 1/2W
R216 1K 2W
R217 330 1/2W
FALL
R218 2.2K 1/2W
R219 1K 2W
R220 330 1/2W
POLARITY
S205
-30V
NORMAL
INV
+15V
SINGLE
DOUBLE
S207
-15V
PULSE MODE
TIMING CIRCUIT BOARD
SCHEMATIC D-11593
P.C.BOARD# 11395
OUTPUT CIRCUIT BOARD
SCHEMATIC D-11594
P.C.BOARD # 10953
R213 3.9K 1/2W
R214 1K
AMPLITUDE
R103 500
AMP SET
R221 5.1K 1/2W
R222 10K 1/2W
+15V
ATTENUATOR
SCHEMATIC
C-11595
S206
R207 470
S208
SINGLE SYCLE
J201
J202
TRIGGER WIDTH
R208 5K 2W
J203
EXT DRIVE INPUT
GATE INPUT
TRIGGER OUTPUT
C201, .015
C202, .047
C203, .15
C204, .47
C205, 1.5
C206, 4.7
C207, 15
C208, 47
C209, 47
C210, 47
C211, 47
C212, 20PF
C213, 20PF
C214, 75PF
C215, 10 PF
C216, 400PF
C217, .0015
C218, 4300PF
POWER SUPPLY
& REGULATOR BD.
SCHEMATIC D-11592
P.C. BOARD # 10938
1
6
7
13
18
+15V
-15V
-25V
-30V
J204
OUTPUT 50Ω
CONFIDENTIAL INFORMATION
NO INFORMATION GIVEN HEREIN MAY BE DISSEMINATED TO ANY PERSON OR COMPANY WITHOUT THE EXPRESS PERMISSION OF E-H RESEARCH LABORATORIES, INC.
ITEM NO. PART NO. DESCRIPTION QTY
MATERIAL LIST
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
DECIMALS ± .XX in ± .XXX —
ANGLES ±
MACHINED SURFACES
DO NOT SCALE DRAWING
E-H RESEARCH LABORATORIES, INC.
OAKLAND, CALIFORNIA
TITLE
MASTER SCHEMATIC
MODEL 139 B
DRAWN PBW 3-30-66
CHK'D 10/14/66
D-11591
ISSUE E
NEXT ASSY
USED ON 139B
APP'D

REF	FP	BD
C	243	19
CR		42
R	211	75
Q		19
L		5

REVISIONS

ISSUE	REVISION	DATE	DRAWN	CHK'D	APP'D	E.O.
A	ORIG. RELEASE	7-20-65	CD			
B	C205 - 1.5MFD; R202 - 4.7K TO 3.9K	11-4-65	CD			65-99
C	R49 & 57 WAS 1/4 W.	11-16-65	S.R.			65-102
D	R68 & R75 WERE 180 OHMS	1-2-66	CD			65-124
E	R30 WAS 470, C15 WAS .001	2-17-66				66-35

DELAY S202

WIDTH S203

FREQ RANGE S201 EXT

PULSE MODE

SINGLE DOUBLE S207

CLOCK CIRCUIT

DELAY CIRCUIT

WIDTH CIRCUIT

EXTERNAL DRIVE AND GATE CIRCUIT

TRIGGER CIRCUIT

663-072 EMITTER FOLLOWER

ASTABLE MULTI

663-009

11722 SATURATING SWITCH

11701 EMITTER FOLLOWER

CURRENT MODE SWITCH

DELAY MONOSTABLE MULTI

WIDTH MONOSTABLE MULTI

MONO-STABLE MULTI

663-009 EMITTER FOLLOWER

374-022

P.C. BOARD # 11395

CHASSIS GROUND

GATE INPUT

TRIGGER WIDTH

TRIGGER OUTPUT

EXT DRIVE INPUT

SINGLE CYCLE

TO OUTPUT BD. (E)

TO OUTPUT BD. (D)

RG 174/U 13'-6"

CONDITIONS FOR WAVEFORMS

FREQ — 100Kc (30 — 100Kc RANGE)
DELAY — 1μs
WIDTH — 1μs
RAMP RATE/10V — 100 ns
OFFSET — 0v
POLARITY — + NORMAL
AMPLITUDE — +10V
SCOPE — 30 Mc (TEKTRONIX 514/L)

UNLESS NOTED:

1. ALL RESISTANCE IN OHMS
2. ALL RESISTORS 1/4 W, 5%
3. ALL CAPACITANCE IN MICRO-FARADS
4. ALL DIODES ARE 11742
5. ALL TRANSISTERS 11475
6. ① ② DIODES MATCHED PAIRS 11731
   ③ ④ ⑤ —— " —— 11730
7. ALL ROTARY SWITCHES VIEWD FROM REAR

MATERIAL LIST

ITEM NO	PART NO	DESCRIPTION	QTY

E-H RESEARCH LABORATORIES, INC.
OAKLAND, CALIFORNIA

TITLE: TIMING CIRCUIT BOARD SCHEMATIC

MODEL 139B

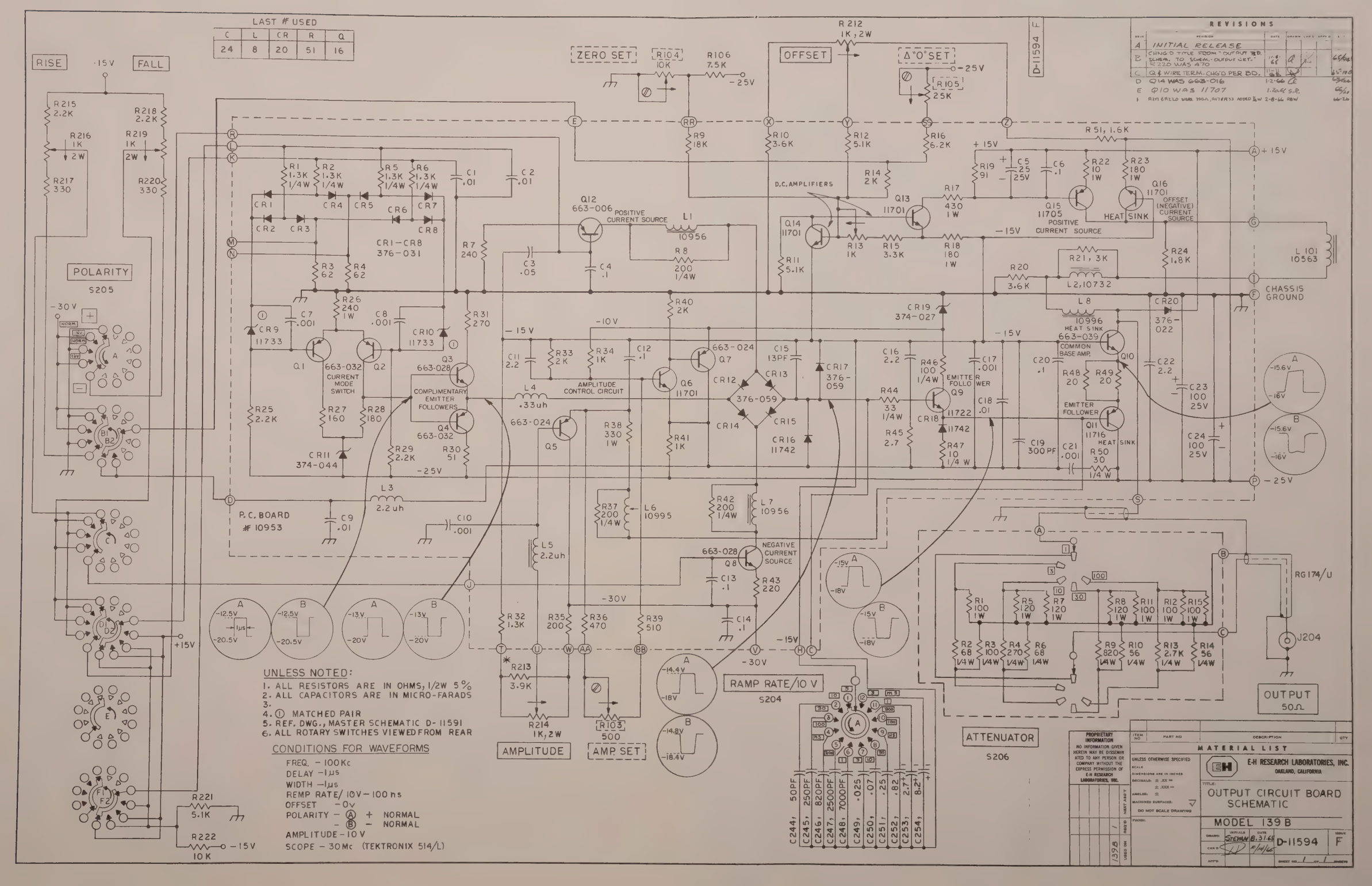
D-11593 ISSUE E

DRAWN CD 7-20-65
CHK'D 11/4/65
APP'D

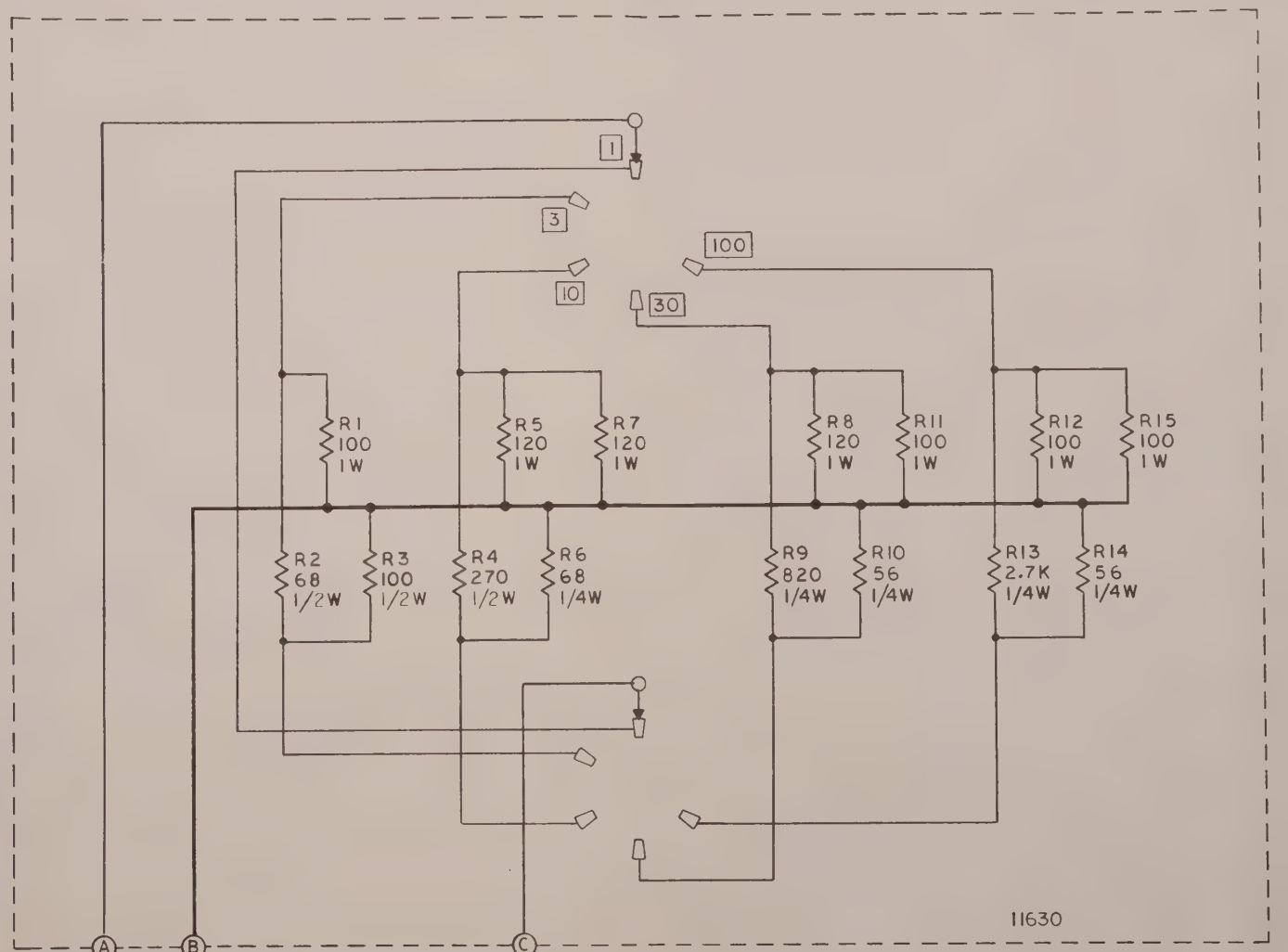
PROPRIETARY INFORMATION: NO INFORMATION GIVEN HEREIN MAY BE DISSEMINATED TO ANY PERSON OR COMPANY WITHOUT THE EXPRESS PERMISSION OF E-H RESEARCH LABORATORIES, INC.

UNLESS OTHERWISE SPECIFIED: DECIMALS ± .XX ; ± .XXX ; ANGLES ± ; MACHINED SURFACES ; DO NOT SCALE DRAWING ; FINISH

NEXT ASSY / REQ'D / USED ON 139B


LAST # USED
C 24 | L 8 | CR 20 | R 51 | Q 16
D-11594 E
REVISIONS
A INITIAL RELEASE
B CHNG'D TITLE FROM "OUTPUT BD. SCHEM. TO SCHEM. OUTPUT SET." R220 WAS 470
C Q4 WIRE TERM. CHG'D PER BD.
D Q14 WAS 663-016
E Q10 WAS 11707
F R21 & R22 WERE 390Ω, R47 & R33 ADDED ¼W 2-8-66 RBW
RISE
FALL
-15V
ZERO SET
R104 10K
R106 7.5K
-25V
OFFSET
R212 1K, 2W
Δ"O" SET
R105 25K
R215 2.2K
R218 2.2K
R216 1K 2W
R219 1K 2W
R217 330
R220 330
R1 1.3K 1/4W
R2 1.3K 1/4W
R5 1.3K 1/4W
R6 1.3K 1/4W
C1 .01
C2 .01
CR1
CR2
CR3
CR4
CR5
CR6
CR7
CR8
CR1-CR8 376-031
POLARITY
S205
-30V
NORM
INV
UNK
1MV
A
B1
B2
C
D1
D2
+15V
E
F1
F2
R221 5.1K
R222 10K
-15V
R3 62
R4 62
R7 240
C3 .05
C4 .1
Q12 663-006
POSITIVE CURRENT SOURCE
L1 10956
R8 200 1/4W
R9 18K
R10 3.6K
R12 5.1K
R16 6.2K
R14 2K
D.C. AMPLIFIERS
Q13 11701
Q14 11701
R11 5.1K
R13 1K
R15 3.3K
R17 430 1W
R18 180 1W
R19 91
C5 25 25V
C6 .1
Q15 11705
POSITIVE CURRENT SOURCE
R22 10 1W
R23 180 1W
Q16 11701
HEAT SINK
OFFSET (NEGATIVE) CURRENT SOURCE
+15V
R51, 1.6K
R21, 3K
L2, 10732
R20 3.6K
R24 1.8K
L 101 10563
CHASSIS GROUND
L8 10996
HEAT SINK 663-039
COMMON BASE AMP.
Q10
CR19 374-027
CR20 376-022
C22 2.2
C23 100 25V
C24 100 25V
R26 240 1W
C7 .001
C8 .001
CR9 11733
CR10 11733
Q1
Q2 663-032
CURRENT MODE SWITCH
Q3 663-028
Q4 663-032
COMPLIMENTARY EMITTER FOLLOWERS
R25 2.2K
R27 160
R28 180
R29 2.2K
R30 51
CR11 374-044
R31 270
R40 2K
-10V
-15V
C11 2.2
R33 2K
R34 1K
C12 .1
Q6 11701
Q7 663-024
AMPLITUDE CONTROL CIRCUIT
L4 .33uh
Q5 663-024
R38 330 1W
R41 1K
C15 13PF
CR12
CR13
CR14
CR15
376-059
CR16 11742
CR17 376-059
C16 2.2
R46 100 1/4W
EMITTER FOLLOWER Q9
C17 .001
CR18 11722
R47 10 1/4W
R44 33 1/4W
R45 2.7
C18 .01
C19 300 PF
C20 .1
R48 20
R49 20
EMITTER FOLLOWER Q11 11716
HEAT SINK
C21 .001
R50 30 1/4W
-25V
L3 2.2 uh
P.C. BOARD # 10953
C9 .01
C10 .001
R37 200 1/4W
L6 10995
R42 200 1/4W
L7 10956
L5 2.2uh
663-028 Q8
NEGATIVE CURRENT SOURCE
C13 .1
R43 220
C14 .1
R32 1.3K
R35 200
R36 470
R39 510
-30V
R213 3.9K
R214 1K, 2W
AMPLITUDE
R103 500
AMP SET
RAMP RATE/10 V
S204
ATTENUATOR
S206
C244, 50PF
C245, 250PF
C246, 820PF
C247, 2500PF
C248, 7000PF
C249, .025
C250, .07
C251, .25
C252, .82
C253, 2.7+
C254, 8.2+
R1 100 1W
R5 120 1W
R7 120 1W
R8 120 1W
R11 100 1W
R12 100 1W
R15 100 1W
R2 68 1/4W
R3 100 1/4W
R4 270 1/4W
R6 68 1/4W
R9 820 1/4W
R10 56 1/4W
R13 2.7K 1/4W
R14 56 1/4W
RG 174/U
J204
OUTPUT 50Ω
UNLESS NOTED:
1. ALL RESISTORS ARE IN OHMS, 1/2W 5%
2. ALL CAPACITORS ARE IN MICRO-FARADS
3.
4. Ⓘ MATCHED PAIR
5. REF. DWG., MASTER SCHEMATIC D-11591
6. ALL ROTARY SWITCHES VIEWED FROM REAR
CONDITIONS FOR WAVEFORMS
FREQ. - 100Kc
DELAY -1μs
WIDTH -1μs
REMP RATE/ 10V - 100 ns
OFFSET -0v
POLARITY - Ⓐ + NORMAL
- Ⓑ - NORMAL
AMPLITUDE - 10 V
SCOPE - 30Mc (TEKTRONIX 514/L)
PROPRIETARY INFORMATION
NO INFORMATION GIVEN HEREIN MAY BE DISSEMINATED TO ANY PERSON OR COMPANY WITHOUT THE EXPRESS PERMISSION OF E-H RESEARCH LABORATORIES, INC.
MATERIAL LIST
E-H RESEARCH LABORATORIES, INC.
OAKLAND, CALIFORNIA
OUTPUT CIRCUIT BOARD SCHEMATIC
MODEL 139 B
D-11594
F

REVISIONS						
ISSUE	REVISION	DATE	DRAWN	CHK'D	APPV'D	E.O
A	INITIAL RELEASE	8.31.65	S.R			



C-11595 | A

PROPRIETARY INFORMATION
NO INFORMATION GIVEN HEREIN MAY BE DISSEMINATED TO ANY PERSON OR COMPANY WITHOUT THE EXPRESS PERMISSION OF E-H RESEARCH LABORATORIES, INC.

ITEM NO	PART NO.	DESCRIPTION	QTY

MATERIAL LIST

UNLESS OTHERWISE SPECIFIED
SCALE
DIMENSIONS ARE IN INCHES
DECIMALS. ± .XX = ± .XXX =
ANGLES: ±
MACHINED SURFACES: √
DO NOT SCALE DRAWING
FINISH

NEXT ASS'Y	REQ'D	USED ON
	1	171
	1	139B

E-H RESEARCH LABORATORIES, INC.
OAKLAND, CALIFORNIA

TITLE
ATTENUATOR SWITCH
SCHEMATIC

MODEL: 139B

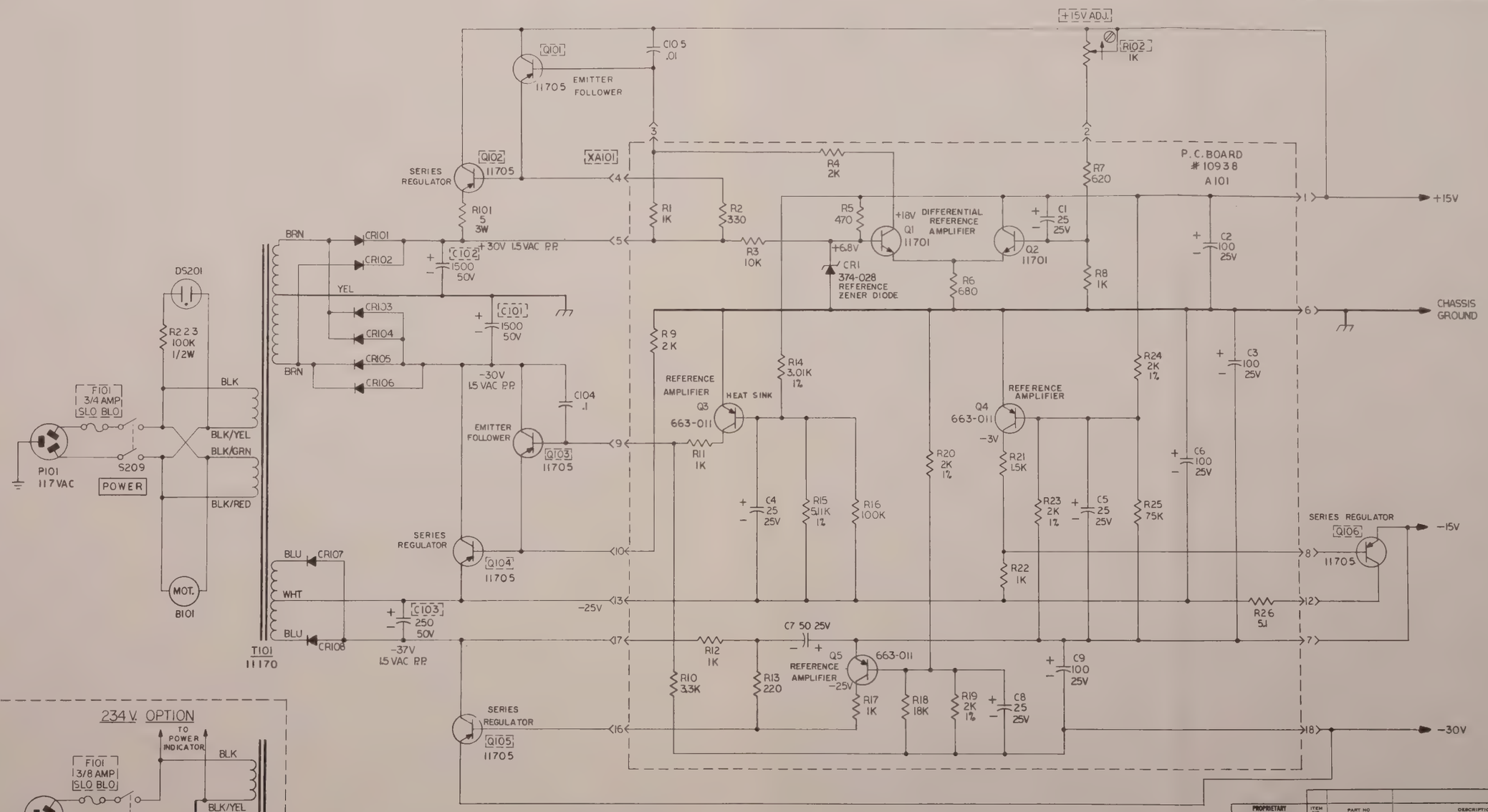
	INITIALS	DATE		ISSUE
DRAWN	STEVAN	8.31.65	C-11595	A
CHK'D		10/14/65		
APP'D			SHEET NO 1 OF 1 SHEETS	

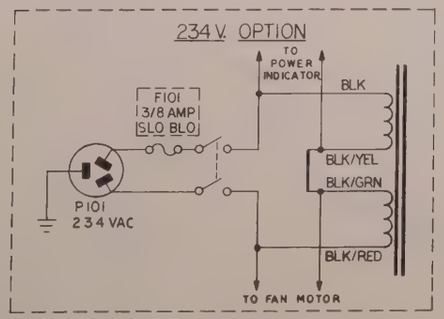
REF	PS	A101
C	105	9
CR	108	1
R	102	26
Q	106	5

D-11592 B

REVISIONS

ISSUE	REVISION	DATE	DRAWN	CHK'D	APP'D	E.O.
A	ORIG. RELEASE	7-65	CD			
B	R9 ADDED	1.21.66	S.R.			





UNLESS NOTED:

1. ALL RESISTORS IN OHMS, 1/2 W. 5%
2. ALL CAPACITORS IN MICRO-FARADS
3. D.C. VOLTAGES TAKEN AT LINE OF 117VAC WITH 20,000 OHM/VOLT METER
4. Q3 REQUIRES HEAT SINK 15 · 490-018
5. CR101-CR108 ARE 376-034

PROPRIETARY INFORMATION
NO INFORMATION GIVEN HEREIN MAY BE DISSEMINATED TO ANY PERSON OR COMPANY WITHOUT THE EXPRESS PERMISSION OF E-H RESEARCH LABORATORIES, INC.

ITEM NO	PART NO	DESCRIPTION	QTY

MATERIAL LIST

UNLESS OTHERWISE SPECIFIED
SCALE
DIMENSIONS ARE IN INCHES
DECIMALS ± .XX ± .XXX
ANGLES ±
MACHINED SURFACES
DO NOT SCALE DRAWING
FINISH

NEXT ASS'Y 1398 USED ON REQ'D 1

E-H RESEARCH LABORATORIES, INC.
OAKLAND, CALIFORNIA

TITLE
POWER SUPPLY & REGULATOR BOARD SCHEMATIC
MODEL 139 B

	INITIALS	DATE
DRAWN	CD	7-30-65
CHK'D		10/14/66
APP'D		

D-11592 B

SHEET NO. 1 OF 1 SHEETS

SUMMARY... PULSE GENERATORS

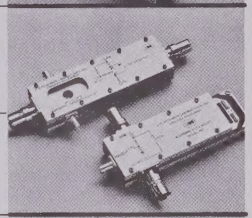
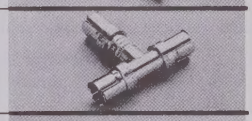
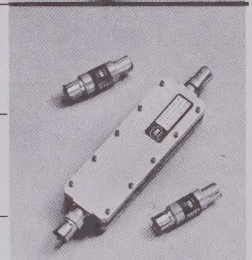
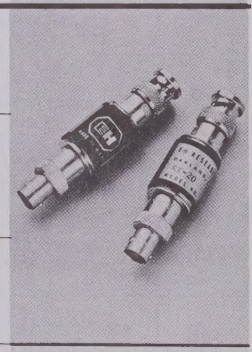
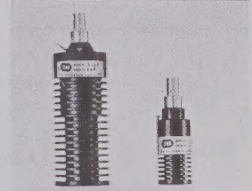
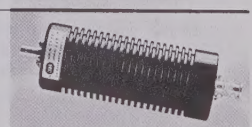
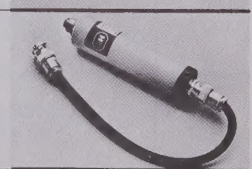
v=volts
a=amperes
Ω=ohms (omega)

Time abbreviations:
ps=picoseconds
ns=nanoseconds
μs=micro seconds
ms=milliseconds

MODEL	FEATURE	CLOCK	AMPLITUDE	RISETIME	WIDTH	DELAY	DUTY FACTOR	PRICE
120D	fast clean waveform at high rep rates	100 cps to 20 Mc	dual pulses −7 to −20v	<1.0ns at 10v <1.5ns at 20v	10 ns to 100 ns	fixed 100 ns	15% max	$1375
120E	same as Mod 120D, with attenuator	100 cps to 20 Mc	dual pulses −70mv to −20v	<1.3ns at 10v <1.5ns at 20v	10 ns to 100 ns	fixed 100 ns	10% max	$1675
121	1a into 50Ω at 5 ns	10 cps to 10 Mc	±5v to 50v	<5.0ns at 50v	30 ns to 1 μs	fixed 120 ns	20% max	$1675
122	rep rates to 200 Mc tr <1.0 ns	1 kc to 200 Mc	±150mv to 5v	<1.0ns at 5v	2 ns to 100 μs	2 ns to 100 μs	>40%	$2875
123A	1a into 50Ω at 50% duty factor	1 kc to 20 Mc	±200mv to 50v	<7.0 ns	20 ns to 300 μs	50 ns to 100 μs	>50%	$1775
125	clean 200 ps rise-time at 1 Mc	10 cps to 1 Mc	−10v fixed	<200 ps	<1 ns to 100 μs	100 ns to 100 μs	10% max	$2275
126	clean 400 ps edge, to 100v	40 cps to 300 cps	0v to ±100v	<400 ps	2/20/70/90ns internal lines	none	not applicable	Consult factory
130	double pulse output	10 cps to 2 Mc	500 ma or 50v	10 ns	150 ns to 50 ms	150 ns to 50 ms	50% max	$1175
131	1a into 50Ω at low cost	10 cps to 100 kc	±100mv to 50v	<10 ns	100 ns to 500 μs	−1 μs to 1 ms	10% at 50v 20% at 25v	$ 575
132A	1a into 50Ω at 3.5 Mc	5 cps to 3.5 Mc	±400mv to 50v	<12ns to 100 ns	100 ns to 10 ms	100 ns to 10 ms	25% at 50v 50% at 25v	$ 715
133A	1a into 50Ω variable linear ramp	1 kc to 5 Mc	±200mv to 50v	<10 ns to 10 μs	50 ns to 300 μs	75 ns to 100 μs	>50%	$2275
138	dual outputs both polarities	300 cps to 10 Mc	±75mv to 7.5v	<10 ns	50 ns to 1 ms	50 ns to 1 ms	>50%	$ 890
139B	versatile 10v ramp at 50 Mc rates	10 cps 50 Mc	±30mv to 10v	6 ns to 3 ms	10 ns to 10 ms	10 ns to 10 ms	>50%	$1275
171	digital xtal timing remote programming	100 cps to 5 Mc	±30mv to 10v	6 ns to 100 μs	100 ns to 9.98 ms	none	no restriction	$2875
1030	frame & p.s. for 3 ea. 1033 plug-ins	none, requires external clock	±20v to 50v	10 ns to 10 μs	dependent on external timing	dependent on external timing	>50%	$1150
1033	2 independent 1a outputs variable linear ramp							$2575
1121	50v at 2 ns, ±5v offset remote programming	none	±500mv to 50v	<2.0ns at 50v	1 μs max	dependent on external timing	10% max	$2925
5112	high voltage pulse amplifier	none	−150v −400v	<20ns at 150v <25ns at 400v	dependent on external timing	dependent on external timing	0.3% max	$2695

All prices F.O.B. Oakland, California
Prices and Technical Data subject to change without notice.

PULSE ACCESSORIES

	MODEL	FUNCTION	DESCRIPTION	PRICE	
GR SERIES	901	MARKER GENERATOR	A passive circuit designed to provide 1 ns markers for time-base calibration. 1% accuracy, requires fast pulse to activate. GR connectors.	$220	
	902	TUNNEL DIODE PULSER	Produces 450 mv pulse at less than 100 ps rise time from slower pulse or sine waveforms applied to input. —1 volt required to switch tunnel diode. BNC input, GR output.	$190	
	950	TRANSISTOR MOUNT	A 50 ohm transmission line mount for measurement of transistor switching times to the sub-nanosecond region. AC coupled output. BNC DC inputs, GR signal in and out.	$340	
	951	DIODE MOUNT	A 50 ohm transmission line mount for measurement of diode switching times to the sub-nanosecond region. BNC bias input, GR signal in and out.	$340	
	960	TAP-OFF	A 50 ohm transmission line sampling device. 100:1 pickoff ratio. No appreciable discontinuity introduced into 50 ohm systems to 3 Gc. GR connectors.	$90	
	970	DC RESTORER	Clamps baseline to ground to eliminate shift in AC coupled sub-nanosecond pulse systems. Peak input 20 volts. Approx. 10% attenuation. Specify pos. or neg. polarity-GR connectors.	$90	
	971	RISE TIME STANDARD	Produces fixed, repeatable rise times from fast pulse inputs. Made in std times of 5, 2, 1, 0.5, 0.2 nanosecond, ±10%. Printed circuit stability. GR connectors.	$170	
	972	PULSE TRANSFORMER	A fast inverting transformer for 50 ohm systems. Rise time better than 0.25 ns. GR connectors.	$90	
BNC SERIES	ZT	PULSE TRANSFORMER	Nanosecond transformers for impedance matching or inversion. Impedances 50, 93, 125, 185, 200 ohms. Any combination input to output with or without inversion. BNC connectors.	$35	
	DT	DC RESTORER	Clamp designed to eliminate baseline shift in AC-coupled nanosecond pulse systems. Peak input 20 volts. Approximately 10% attenuation. DTP for positive pulses, DTN for negative. BNC connectors.	$60	
	RT	RISE TIME INTEGRATOR	For repeatable, fixed, known times from fast pulse input. Standard models at 5, 10, 20, 50, 100 ns. Special times on request. 10% accuracy, 0.5 amp max. average. BNC connectors.	$35	
	ZL-3 ZL-15	TERMINATIONS	Three watt and fifteen watt terminations for 50 ohm pulse systems. DC resistance accurate to 1%. VSWR <1.25 at 100 Mc. Scope tap. BNC connectors.	$55 $75	
	TP-2 TP-5 TP-10	ATTENUATORS	High power fixed attenuators with 2:1, 5:1, 10:1 ratios. Division ratios accurate to 10%. 12 watts max. continuous dissipation. For 50 ohm input and output. VSWR <1.25 at 100 Mc. BNC connectors.	$95	
	SP-10	SINGLE PULSE TRIGGER	A battery-operated triggering device for single-pulsing all E-H pulsers. Supplies a fast-rise 10 volt spike of either polarity. With cable. BNC connectors.	$45	
	CX-5	CABLE SET	Two five-foot lengths of RG58A/U, 50 ohm cable with male BNC connectors.	$18	

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